begins to move, not to move in the usual way (that which *is* automatic during life), but in an unusual manner, which must have been very rarely, if at all, used during life, and when used must have been purely conscious and voluntary? I think I cannot be mistaken in considering this to require some explanation. It may be that the frog is constantly, during life, crossing one foot over to rub the opposite side of the body; but we cannot accept this as an explanation unless it has been observed to be a fact. What puzzles me is, that Prof. Huxley, Dr. Carpenter, and Mr. Darwin, all refer to this case as an example of reflex action, and none of them see any difficulty in it, or seem to think that it requires any more explanation than the remaining quite intelligible cases. As others may, like myself, feel the difficulty I have endeavoured to point out, I hope some of your physiological correspondents will enlighten us if they can.

ALFRED R. WALLACE

Supernumerary Rainbow

IN Mr. Backhouse's letter (NATURE, vol. x. p. 437) he remarks that the supernumerary rainbow is commonly seen only in the upper part of the arch. Dr. Thomas Young, in his Bakerian Lecture ("Works," vol. i. p. 185, or Phil. Trans. 1804), after explaining the supernumerary bow by interferences, quotes a paper in vol. xxxii. of the Phil. Trans., in which Dr. Langwith describes his observation of a supernumerary bow on August 21, 1722; then remarks: "I have never observed these inner orders of colours in the lower parts of the rainbow. I have taken notice of this so often that I can hardly look upon it as accidental; and if it should prove true in general, it will bring the disquisition into a narrow compass; for it will show that this effect depends upon some property which the drops retain whilst they are in the upper part of the air, but lose as they come lower and are more mixed with one another." But I am not aware that anyone has ever remarked an appearance which struck me on seeing a few days ago a very complete primary and secondary bow with a portion of two supernumerary bows within the primary and about the highest part of the arch. To my eye the supernumerary bows were *not concentric* with the primary. My son agreed with me as to this appearance when I pointed it out to him; yet I thought it was probably an illusion till the following explanation occurred to me.

The rain-drops may be presumed to be smaller high in the air, and to increase as they descend.

Now, the smaller drops produce wider interference fringes than the larger drops do. Hence the supernumerary bow is widest and therefore farthest from the primary at the top of the arch, and gets narrower and nearer to the primary as it descends the arch on each side, and "in the lower parts" ultimately fines away to nothing. According to this theory the supernumerary bow is not always concentric with the primary, nor indeed circular.

It should be observed that another reason for the interference bow being seen most frequently at the highest part of the bow is that the small drops high in the air are probably more uniform in size than the larger drops lower down.

Oct. 8 JOSEPH BLACKBURN

Colour in Flowers not due to Insects

THE doctrine that the conspicuous colours of flowers are entirely due to the necessity for cross-fertilisation by the agency of insects seems to be taking the world by storm. It is supported by Mr. Darwin and Sir John Lubbock. It could scarcely be put forward on better authority. Yet there are several facts with which it does not harmonise. For instance—

1. *Cultivation* increases the size and colour of flowers quite independently of the existence or non-existence of insects.
2. *Double flowers* in which the doubling arises from metamorphosis of stamens or pistils are more showy than the single forms, yet insects can be of little use to them, since they are either partially or entirely barren. The double-blossomed cherry is brilliantly conspicuous, but it bears no fruit.
3. Such *abortive flowers* as the cultivated Guelder Rose and Hydrangea depend for their beauty upon the destruction of the reproductive organs. If their increased splendour is meant only as a lure to insects, it is surely an absurd failure.
4. The *autumn colours* of leaves and fruits can serve no such purpose, yet these are often as bright and conspicuous as the flowers of summer.
5. *Fungi* and *lichens* exhibit brilliant colours, which can have nothing to do with insect-fertilisation.

Do not these facts indicate that though insects may be attracted by conspicuous colours, and may have some influence in the maintenance of coloured species, there is yet a deeper and more permanent cause for the colour itself?

Leicester, Oct. 11. F. T. MOTT

Habits of Squirrels

WOULD you permit me to ask of your readers a question or two upon the habits of squirrels? I have had one in my possession, from the age of three weeks, for more than two years. I have noticed that whenever it cleans itself, after licking, it *sneezes* violently three or four times into its forepaws, then rubs them thus damped over its fur. It seems to have the power of sneezing at volition.

Now, is this habit of sneezing, for the purpose of cleaning itself, a habit peculiar to squirrels; or is it shared by other animals?

I notice also that frequently when it is going thoroughly to clean itself it jerks its forepaws over its ears, bringing them back over its eyes, and always causing a milky liquid to suffuse the eyes. This liquid swims over the eye, and then is absorbed. I have thought that it may use this secretion also for the purpose of moisture. The animal is in perfect health and splendid condition.

A squirrel I had three years ago also had this habit, though in a slighter degree. D. T.

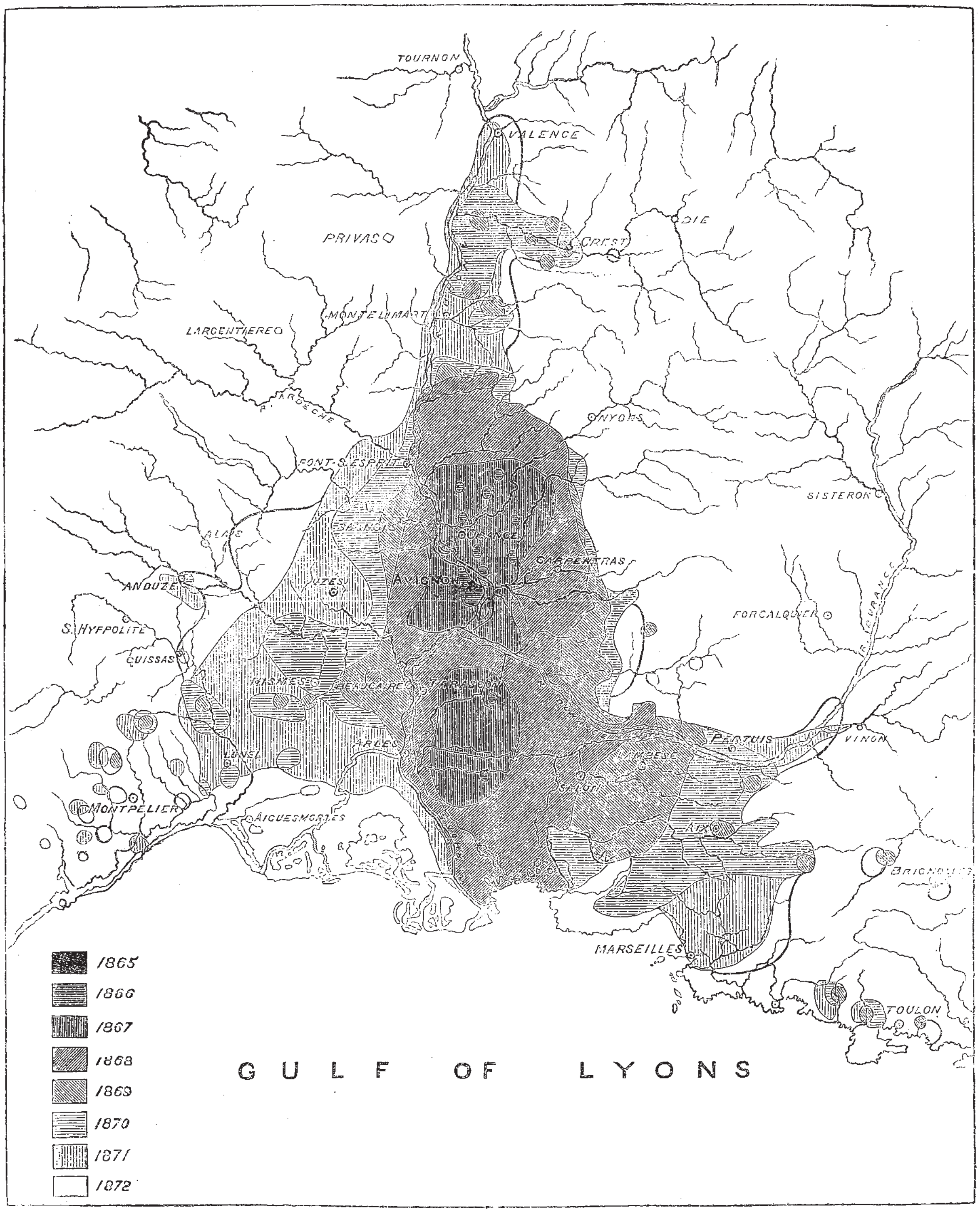
THE NEW VINE-DISEASE IN THE SOUTH-EAST OF FRANCE

I.

WE have before us the Reports presented to the French Academy of Sciences by the delegates of the Commission appointed by that body to investigate the phenomena of the new and terrible disease of the vine in the south-east of France—a disease which is fraught with the most serious consequences to the material prosperity of that country, which depends on its wine as a source of national wealth not less important than are our coal and iron to us.

It was in the autumn of the year 1871 that the Academy of Sciences directed special attention to the communications which poured in upon it from all quarters relative to the ravages of the new parasite of the vine in the South of France; and at the sitting on the 25th September in that year, it charged a Commission, consisting of M. Dumas as president, MM. Milne-Edwards, Duchartre, and Blanchard, to investigate the means of coping with the disease. The Commission examined with the greatest care all the manuscripts and printed monographs which were brought under its notice, and paid particular attention to the scrutiny of the leaves and the roots attacked by the *Phylloxera vastatrix* (for such is the name which has been given to the new insect), which had been sent to it from different places in France; and, with the object of giving to its labours the active direction necessary in such circumstances, it decided to confide the execution of them to three delegates, viz. MM. Balbiani, Max Cornu, and Duclaux, whose learned researches in zoology, botany, and chemistry, suggested recourse to them, and they were accordingly charged with the pursuit of all the observations which the subject would allow of, on the actually affected territory.

It is worth our while, at the outset, to observe the thorough and methodical manner in which an attempt has been made to wrestle with this new enemy of the material welfare of France, and the application of the resources of science to unravel as exhaustively as possible the causes and manner of extension of the invasion of the parasite from its first appearance till the present time. We in England are too apt in similar crises to neglect the practical employment of scientific means, to depend on private and individual exertions for the investigation and treatment of the different causes which threaten the national wealth or prosperity; and though in the long run perhaps we come out of the difficulty in a manner not altogether unsatisfactory, still such result can only be obtained at the expense of interests to which speedy action and prompt methodical treatment are the only means of preservation. But in France and in most of the continental countries of



Map showing the spread of *Phylloxera* from 1865 to 1872.

Europe, the State, or at least important corporate bodies, come quickly to the aid of science, which, thus subsidised and encouraged, can penetrate far deeper and can have a freer play for its researches. As a result, in the present case we have the studies of men of science on this subject of altogether national importance, studies which, if we mistake not, should go far to direct the efforts of the nation into the right course of treatment for the extirpation of this alarming scourge, which has destroyed the produce of so many of the fairest vineyards of the south-east of France.

It is a matter of no difficulty to master the history of the new disease produced by the *Phylloxera*, and to trace its growth from the earliest beginnings. The first definite signs of the invasion of the parasite were observed in the year 1865, at a spot (plainly marked in the maps annexed to the report of M. Duclaux, and now copied for our readers) on the plateau of Pujaut, near Roquemaure, in the neighbourhood of Avignon, and in the department of the Gard, on the west bank of the river Rhône. Though in this year it attracted but little attention, in 1866 it descended rapidly from the plateau to the outskirts of the village of Roquemaure, and also appeared in several spots in the departments of Vaucluse and the Bouches du Rhône, both lying on the east side of the river-valley. It was the owner of a vineyard in this latter department, a M. Delorme, of Arles, who was the first to recognise the disease, while still in the birth, as a new disease, and to have the presentiment of the disasters which would follow in its train. At a later period a commission of the Society of Agriculture of the Hérault visited by request the vineyards around Saint-Rémy, and a member of that commission, M. Planchon, discovered that the cause of the vine-disease was an insect "destined to be the subject of so much discussion, and to become the source of so much misery." It was he who afterwards gave the parasite the name which it has since borne everywhere—*Phylloxera vastatrix*.

Before proceeding to describe the ravages of the insect and the manner in which it ultimately causes the death of the vine, it will be well to show the progressive extension of the disease itself over the country adjacent to the Rhône valley and lying inland to the north of the Gulf of Lyons. M. Duclaux has shown us, in his series of maps annexed to his report, the progress of the disease between the years 1865 and 1872, and marks it as gradually extending from the little spot first attacked in the neighbourhood of Avignon till in the last of those years it included the whole country between Valence on the north and Marseilles on the south, while westwards and eastwards it extended to Montpellier and Aix respectively, thus covering, roughly speaking, nearly four departments, viz., the Gard, the Drome, Vaucluse, and Bouches du Rhône. We are told in the memoir of M. Louis Faucon, also presented to the Academy of Sciences, and embracing a later period than that of M. Duclaux, that the disease extended to an alarming degree in the year 1873, at the same or a greater progressive rate, and had established itself in that year in no less than twelve departments of South-east France, having spread into the Ardèche, the Basses-Alpes, Var, Isère, Hérault, and even reaching so far as the Gironde and the two Charentes.

We may gain a more precise idea than can be afforded by a mere observation of the geographical extension of the disease, of the disastrous nature of the ravages of the *Phylloxera*, by the examination of some of the statistics of the grape-crop in successive years in some of the departments attacked. Thus, in the department of Vaucluse, where the disease showed itself in 1866, there were in 1869, according to the results obtained by the departmental commission instituted at Avignon to observe on the new vine-disease, 6,000 hectares absolutely dead or dying, and a much larger number already attacked, which have since succumbed to the parasite. Out of the 30,000 hectares of vineyard comprised in this department, 25,000, or five-sixths of the total area, have been destroyed. In the Gard, where the vine flourishes better than in the above-mentioned department, the ravages of the disease are yet most terrible, for in 1871, in the arrondissement of Uzès, but one-half of the average crop was produced, and in the arrondissement of Nismes, a tenth part of the crop was destroyed. These proportions, moreover, have increased since that year.

If we examine the mischief done in the less extended areas of the communes, we shall obtain a still clearer idea of the rapid spread of the disease:—

COMMUNE OF GRAVESON.

1865-66-67	mean crop	10,000	hectolitres
1868	„	5,500	„
1869	„	2,200	„
1870	„	400	„
1871	„	250	„
1872	„	100	„
1873	„	50	„

In the commune of Maillanne the crop in 1868 was only 40 per cent. of the average of the three preceding years, while in 1869 it was only 10 per cent. In the commune of Eyragues the crop in 1868 was about 33 per cent. of the average of the three preceding years, and in 1869 there was a further falling off of about 10 per cent. In 1870 the crop in the three above-named communes was almost entirely destroyed. From instances such as these, fairly selected from many others equally tragic in their stern figures, we may form some idea of the magnitude of the disaster. Indeed, it is difficult to see, so rapid is the extension of the disease, how, unless some potent and effective remedy can be soon applied, any vine-bearing district in France can escape the visitation of the *Phylloxera*.

Though there can be no doubt that the *Phylloxera* is the cause of the new vine-disease, this conviction was by no means arrived at at once, nor without considerable doubts being thrown upon it by those whose better judgment was obscured by the confusion of concomitant phenomena such as drought, cold, and impoverishment of the soil with the real source of malady of which they were the companions. Others, even now, hold that the *Phylloxera* is the effect and not the cause of the disease; this idea M. Faucon dissipates satisfactorily in his treatise by the following reasoning:—A vine is watched which is in a perfect state of health and vigour; not a single parasite is discovered in the ramifications of its roots. A day comes when the destructive insect invades it—it resists for some time; the *Phylloxera* lays its eggs, multiplies its numbers, and with them its attacks. The stem of the vine begins to show signs of the disease, and if the roots are laid bare, they may be observed to have deteriorated in some degree from their normal state. The multiplication of the insect continues, and assumes such proportions as to form yellow spots of no small size, the result of the close collection of a large number of the insects, whose puncturings are so numerous and so incessant that the roots can no longer perform their proper function, the nutrition of the plant, which, in consequence, falls into a most evident state of sickliness, lingers on for some time, and eventually dies. The *Phylloxera* takes its first food where it can get it with the least difficulty. After it has exhausted the surface rootlets, tender and succulent as they are, it attacks others deeper down; then it spreads over the hardier roots, till at last the prodigious increase of its family causes it to overrun the whole radical system of the plant, and even the part of the stock of the vine which is underground. It abandons the exhausted plant when it is of no more use to it, and its instinct turns its steps towards a new vine, where it can find fresh food. The work of destruction in a vine, especially if it be vigorous and the soil nutritious, is not completed in a few days. A year may pass without the vine exhibiting any marked sign of sickness. The store of vigour which it contains in itself, added to that which it imbibes for some time after it is attacked in the soil, will permit it during one or even two seasons to perform the double functions of nourishing both itself and the parasite which eventually destroys it. M.

Faucon's observations, confirmed by those of all the other persons who have made positive investigations for themselves, have established that—

1. The number of insects on a plant is in direct and constant accordance with the state of the roots.
2. According as the state of the roots is healthier, is the number of insects greater.
3. The number diminishes in proportion to the exhaustion and consequent death of the roots.
4. On an absolutely dead plant it is impossible to discover a single insect. Surely, therefore, the *Phylloxera* is the cause, and the only cause, of the vine-disease, since its appearance invariably precedes the rotting of the roots, and never follows on their decay.

We postpone till next week the description of the *Phylloxera* itself and the manner in which it attacks and ultimately kills the vine, together with the mention of the various means which have been proposed for the extirpation of the disease.

(*To be continued.*)

*PHYSICS AT THE UNIVERSITY OF LONDON**

AT the present time, when the bulk of the educated population of many countries may be divided into the three classes of *Examinandi*, *Examinati*, and *Examinatores*, a large part of any discussion of what is called the higher education must inevitably be devoted to the question of examinations. Usually, if the matter is discussed from the point of view of those whose business it is to teach, the result is the condemnation of examinations in general as unfavourable to all thorough study; and, from whatever quarter the discussion proceeds, it seems to be taken for granted that the functions of the teacher and those of the examiner are naturally opposed to each other. And indeed no one who has given any attention to the question can doubt but that such an opposition really does exist in very many cases. Originally employed by teachers themselves to consolidate and test the results of their instruction, examinations were at first a natural part of the educational system; but of late years they have rapidly developed into an independent species, which has separated off from the parent organism and now too often tyrannises over it. As of other developments, so of this, we are bound to believe that it is an adaptation to co-existing conditions, and therefore fulfils some useful purposes; but, from the teacher's point of view, as soon as examinations become detached from instruction, and come to be the end of learning instead of a means of teaching, the evils they produce are much more apparent than these benefits. When they have no worse result, they are apt to be viewed by students as affording them an authoritative standard, independent of the judgment of their professors, by which to decide what subjects of study and what parts of these subjects are of sufficient importance to be worthy of their attention. It is therefore not to be wondered at that such examinations should be looked upon by teachers with dislike, as being hindrances and not helps to their work, or that we should hear frequent protests against their excessive multiplication.

While, however, I in general heartily sympathise with such protests, and feel strongly that the difficulty of honest and thorough teaching in my own subject is greatly increased by the regulations for those examinations which, in fairness to the students attending my lectures, I am bound not to lose sight of, it does not seem to me that the remedy for the evils complained of is to be looked for in the abolition of the present examination system. This system is no doubt defective in many ways, and we may perhaps hope that some day it will be replaced by one more accordant with sound educational principles; for the present, however, it exists, and must be recognised as one of the conditions under which our work has to be done. Practical wisdom therefore teaches that instead of trying to get rid of it, we should strive as far as possible to improve it, to lessen its faults, and to develop whatever good it may be susceptible of.

It is admitted on all hands that examinations carried on in direct connection with teaching are of great educational value, of so much value indeed that no careful teacher ever thinks of doing without them. What, therefore, in the interests of sound education, we ought to strive for, in relation to those examinations which are not connected with any system of instruction, is that they should be made, as nearly as possible, what they would be if they did form part of such a system. It is perhaps too much to expect that this should be taken as the leading principle in the case of examinations such as those, now so common in connection with various branches of the public service, which exist for the primary object, not of promoting education, but of preventing dolts and dunces from being supported at the public expense; but, besides these, there are many examinations nowadays, which, though unconnected with teaching, are professedly intended for the advancement of education. Among such examinations, those of the University of London are on many accounts the most important, and the intimate relation between them and much of our work in this College seems to me to be a sufficient reason for considering how far the influence which, through this relation, they exert upon our teaching, is beneficial or otherwise.

If any further justification be needed for discussing the educational tendency of the examinations of the University of London, beyond the general one arising from the paramount importance of the improvement of education, it may be found in the history of the University. It is doubtless known to many of my audience that the University of London was constituted, in most essential respects as it now exists, by a Royal Charter dated December 5, 1837, in order, "for the advancement of religion and morality, and the promotion of useful knowledge, to hold forth to all classes and denominations of [her Majesty's] faithful subjects, without any distinction whatsoever, an encouragement for pursuing a regular and liberal course of education." The form which this encouragement was to take was that of "ascertaining, by means of examination, the persons who have acquired proficiency in Literature, Science, and Art, by the pursuit of such course of education, and of rewarding them by Academical Degrees, as evidence of their respective attainments, and marks of honour proportioned thereto;" and it was directed that all persons should be admitted as candidates for degrees in Arts and Laws, who should produce certificates of having completed the course of instruction prescribed by the University either in *this* College or in King's College, London, or in any other such institution as might be authorised by the Crown to issue such certificates. But in 1858, the Senate of the University obtained a new charter by which they were empowered to admit candidates to the examinations for degrees in Arts, Laws, Science, and Music without requiring them to have previously pursued any prescribed course of study, or to have attended any particular place of instruction; and since that time no other qualification has been demanded of graduates of the University of London (with the exception of those who have taken degrees in Medicine) than the ability to pass the appointed examinations. I do not now propose to discuss the question whether the passing of an examination only affords as good ground for conferring academical distinction as the passing of the same examination combined with studentship at some recognised college or other educational institution; my object at present is

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* Introductory Lecture delivered at the opening of the Session of the Faculties of Arts and Laws and of Science, in University College, London, on Monday, Oct. 5, 1874, by G. Carey Foster, F.R.S., Professor of Physics.